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Sensitivity Analysis and Uncertainty Quantification of the Feynman Y and Sm_2

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Monte Carlo Methods, Codes, and Applications

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Bayo Canyon Trail Hike



Alexander Clark (XCP-3)

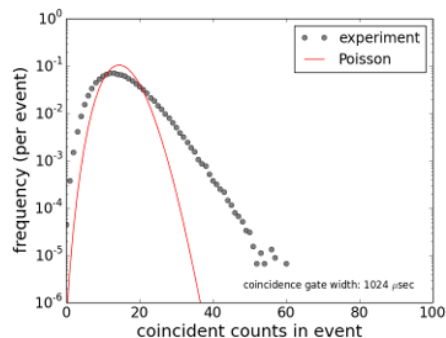
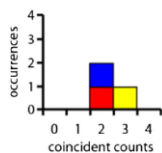
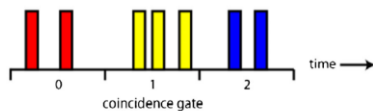
- Educational Background
 - BS, Nuclear Engineering, ISU, 2014
 - PhD, Nuclear Engineering, NCSU, 2019
- X-Computational Physics
 - Monte Carlo Methods, Codes, and Applications
 - Jeffrey A. Favorite
- Research
 - Sensitivity analysis and uncertainty quantification of the Feynman Y and Sm_2
 - Data assimilation of nuclear cross sections applied to neutron multiplicity counting experiments

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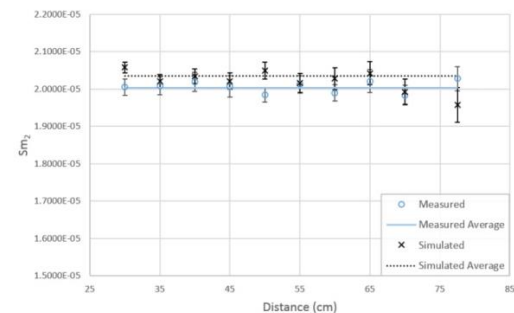
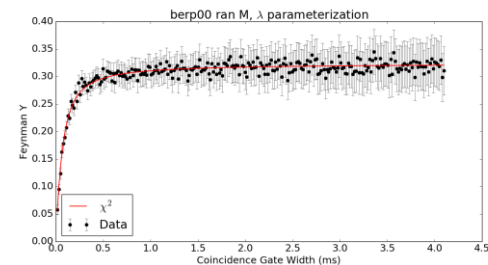
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Research Overview and Motivation



- Neutron multiplicity counting (NMC) is a method of NDA of SNM
- Fission chain-reactions are a non-Poisson distributed process
- Feynman Y used to infer integral properties of SNM e.g. neutron lifetime/multiplication
- Sm_2 is independent of the detector response function
- Reliable characterization of SNM requires SA/UQ of Y and Sm_2



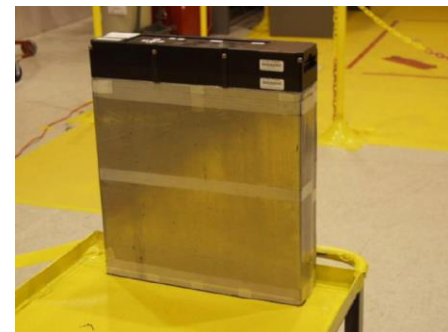
Research Approach

- **PARTISN simulations of neutron multiplicity counting of a 4.5 kg sphere of weapons grade plutonium metal (BeRP ball)**
 - Counted with the nPod neutron multiplicity counter
 - Simulated with:
 - No reflector
 - 3.8 cm of polyethylene
- **First-order, adjoint-based perturbation theory SA approach by Sean O'Brien**

BeRP ball nested in polyethylene reflectors



nPod neutron multiplicity counter



Summary of Results

- Sm_2 has less uncertainty due to nuclear cross sections than Y
- NDA of SNM using Y may be preferred if the detector response function is known *a priori*
- Invariance of Sm_2 to detector response function makes its relationship to reflector thickness or neutron multiplication useful

